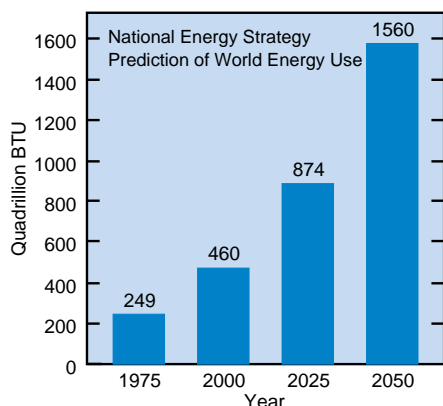


# FUSION ENERGY

## THE PROCESS AND THE PROMISE

Nuclear fusion—the process that powers the stars—is the joining of the nuclei of light atoms, such as those of hydrogen, to form a heavier atom. This process releases much more energy than is needed to make the reaction occur. As the world's energy needs have increased, the limits of its resources are becoming apparent. Fusion energy offers the promise of becoming a safe, economical, abundant, and environmentally acceptable source of power. While the technological challenges of harnessing fusion power are large, significant advances have been and continue to be made.



### Why Do We Need Fusion Energy?

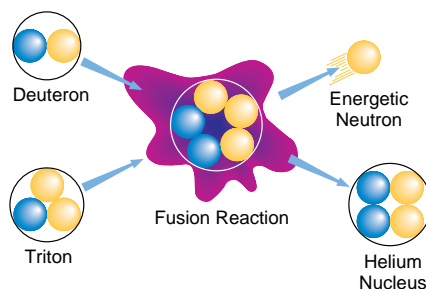
Estimates of the need for energy in the future take into account population growth and increasing urbanization and industrialization throughout the world. Some predictions indicate that about four times as much energy will be needed by the year 2050 as is used today.

The principal sources of this energy include fossil fuels (coal, gas, and oil), nuclear fission fuel, and various forms of solar energy. For all of these sources, varying degrees of uncertainty exist and will continue to exist regarding the extent and security of fuel reserves, environmental effects, plant availability, and economic cost. Fusion energy, while not devoid of some of these uncertainties, has significant potential to become an important addition to the mix of energy sources that will be required to satisfy the energy needs of future generations throughout the world.

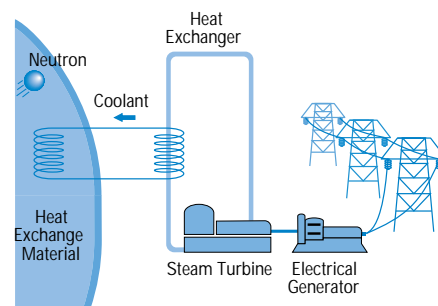
### How Does Fusion Energy Work?

In nuclear fusion, the nuclei of light atoms combine, or fuse, to form the nucleus of a heavier atom. The new nucleus is lighter than the original two, and the “extra” mass is released as energy according to Einstein’s famous equation,  $E = mc^2$ . In the sun, hydrogen is converted into helium through a series of fusion reactions, and the energy is released in the form of sunlight.

In the reaction most likely to be used in the first fusion power plants, the nuclei of two isotopes of hydrogen, deuterium and tritium, fuse and create the nucleus of a helium atom (also called an alpha particle) and a neutron. Most of the energy of the reaction is carried by the neutron.



In a fusion reactor, neutrons would be absorbed by a surrounding “blanket” that would convert their energy to heat. This heat would be used to generate steam for driving an electric turbine generator. The fusion energy that could be released by a single gram of deuterium-tritium fuel equals the energy from about 2400 gallons of oil.



### What Are the Advantages of Fusion Energy?

Fusion is a potential alternative source of power that has several advantages:

- Deuterium fuel is not radioactive and occurs naturally in water. The supply of this fuel is widely available, virtually unlimited, and free from foreign interdiction, and shipment is routine.
- Tritium, the other principal fusion fuel, is radioactive, but it can be manufactured directly within a fusion reactor plant, through the reaction of fusion neutrons with lithium, which is an abundant element.
- No fission by-products are produced. The fusion reaction waste product, or “ash,” is helium, which is not radioactive.
- Structural radioactivity will occur in metallic components inside a fusion reactor, but the lifetime of the radioactivity can be reduced by using “low-activation” materials.